



J&J-1825.ST25.txt  
SEQUENCE LISTING

<110> Kutchan, Toni M.  
Zenk, Meinhard H.  
Atkins, David G.  
Fist, Anthony J.

<120> CODEINONE REDUCTASE FROM ALKALOID POPPY

<130> J&J-1825

<140> US 09/937,665

<141> 2002-02-20

<150> PCT/AU00/00249

<151> 2000-03-24

<150> AU PP 9463

<151> 1999-03-26

<160> 29

<170> PatentIn version 3.3

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<222> (19)..(19)  
 <223> n = i

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 catntccacn tgattnacna c

21

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<220>  
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<210> 6  
 <211> 21  
 <212> DNA  
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<220>  
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<400> 6  
 gacagtcctc acttaccatc t 21

<210> 7  
 <211> 33  
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<220>  
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<400> 7  
 atggctagca tggagagtaa tgggtgtacct atg 33

<210> 8  
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<210> 9  
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 <223> xaa can be any naturally occurring amino acid

<400> 9

Xaa Leu Gln Glu Leu Met Ala  
 1 5

<210> 10  
 <211> 11  
 <212> PRT  
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<220>  
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<400> 10

Val Leu His Gln Ile Ala Val Ala Arg Gly Lys  
 1 5 10

<210> 11  
 <211> 10  
 <212> PRT  
 <213> Artificial Sequence

<220>  
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<400> 11

Asp Asp Asp Glu Leu Phe Ile Thr Ser Lys  
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<210> 12  
 <211> 16  
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<220>  
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<400> 12

Ile Pro Asp Val Val Asn Gln Val Glu Met Ser Pro Thr Leu Gly Gln  
 1 5 10 15

<210> 13  
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<220>  
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<220>  
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 <223> xaa can be any naturally occurring amino acid

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Xaa Val Asn Glu Ile Pro Lys  
 1 5

<210> 14  
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<220>  
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 <223> xaa can be any naturally occurring amino acid

<400> 14

Xaa Val Ala Gln Val  
 1 5

<210> 15  
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 <213> Artificial Sequence

<220>  
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Ile Phe Asp Asn Xaa Leu Thr Ala Glu Asp  
 1 5 10

<210> 16  
 <211> 230  
 <212> PRT  
 <213> Alfalfa

<400> 16

Lys Gln Gly Tyr Arg His Phe Asp Thr Ala Ala Ala Tyr Gly Ser Glu  
 1 5 10 15

Gln Ala Leu Gly Glu Ala Leu Lys Glu Ala Ile Glu Leu Gly Leu Val  
 20 25 30

Thr Arg Glu Glu Leu Phe Val Thr Ser Lys Leu Trp Val Thr Glu Asn  
 35 40 45

His Pro His Leu Val Ile Pro Ala Leu Gln Lys Ser Leu Lys Thr Leu  
 50 55 60

Gln Leu Asp Tyr Leu Asp Leu Tyr Leu Ile His Trp Pro Leu Ser Ser  
 65 70 75 80

Gln Pro Gly Lys Phe Ser Phe Pro Ile Asp Val Ala Asp Leu Leu Pro  
 85 90 95

Phe Asp Val Lys Gly Val Trp Glu Ser Met Glu Glu Ser Leu Lys Leu  
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100

105

110

Gly Leu Thr Lys Ala Ile Gly Val Ser Asn Phe Ser Val Lys Lys Leu  
 115 120 125

Glu Asn Leu Leu Ser Val Ala Thr Val Leu Pro Ala Val Asn Gln Val  
 130 135 140

Glu Met Asn Leu Ala Trp Gln Gln Lys Lys Leu Arg Glu Phe Cys Asn  
 145 150 155 160

Ala Asn Gly Ile Val Leu Thr Ala Phe Ser Pro Leu Arg Lys Gly Ala  
 165 170 175

Ser Arg Gly Pro Asn Glu Val Met Glu Asn Asp Met Leu Lys Glu Ile  
 180 185 190

Ala Asp Ala His Gly Lys Ser Val Ala Gln Ile Ser Leu Arg Trp Leu  
 195 200 205

Tyr Glu Gln Gly Val Thr Phe Val Pro Lys Ser Tyr Asp Lys Glu Arg  
 210 215 220

Met Asn Gln Asn Leu Cys  
 225 230

<210> 17  
 <211> 230  
 <212> PRT  
 <213> Glycyrrhiza

<400> 17

Lys Gln Gly Tyr Arg His Phe Asp Thr Ala Ala Ala Tyr Gly Ser Glu  
 1 5 10 15

Thr Ala Leu Gly Glu Ala Leu Lys Glu Ala Arg Asp Leu Gly Leu Val  
 20 25 30

Thr Arg Glu Glu Leu Phe Val Thr Ser Lys Leu Trp Val Thr Glu Asn  
 35 40 45

His Pro His Leu Val Ile Pro Ala Leu Arg Lys Ser Leu Glu Thr Leu  
 50 55 60

Gln Leu Glu Tyr Leu Asp Leu Tyr Leu Ile His Trp Pro Leu Ser Ser  
 65 70 75 80

Gln Pro Gly Lys Phe Ser Phe Pro Ile Gln Val Glu Asp Leu Leu Pro  
 85 90 95

Phe Asp Val Lys Gly Val Trp Glu Ser Met Glu Glu Cys Leu Lys Leu  
 100 105 110

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Gly Leu Thr Lys Ala Ile Gly Val Ser Asn Phe Ser Val Lys Lys Leu  
115 120 125

Gln Asn Leu Leu Ser Val Ala Thr Ile Arg Pro Ala Val Val Gln Val  
130 135 140

Glu Met Asn Leu Ala Trp Gln Gln Lys Lys Leu Arg Glu Phe Cys Thr  
145 150 155 160

Ala Asn Gly Ile Val Leu Thr Ala Phe Ser Pro Leu Arg Lys Gly Ala  
165 170 175

Ser Arg Gly Pro Asn Glu Val Met Glu Asn Asp Met Leu Lys Gly Ile  
180 185 190

Ala Glu Ala His Gly Lys Ser Ile Ala Gln Val Ser Leu Arg Trp Leu  
195 200 205

Tyr Glu Gln Gly Val Thr Phe Val Ala Lys Ser Tyr Asp Lys Glu Arg  
210 215 220

Met Asn Gln Asn Leu Gln  
225 230

<210> 18  
<211> 230  
<212> PRT  
<213> Soybean

<400> 18

Lys Gln Gly Tyr Arg His Phe Asp Thr Ala Ala Ala Tyr Gly Ser Glu  
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20 25 30

Arg Ser Gln Asp Leu Phe Val Thr Ser Lys Leu Trp Val Thr Glu Asn  
35 40 45

His Pro His Leu Val Leu Pro Ala Leu Arg Lys Ser Leu Lys Thr Leu  
50 55 60

Gln Leu Glu Tyr Leu Asp Leu Tyr Leu Ile His Trp Pro Leu Ser Ser  
65 70 75 80

Gln Pro Gly Lys Phe Ser Phe Pro Ile Glu Val Glu Asp Leu Leu Pro  
85 90 95

Phe Asp Val Lys Gly Val Trp Glu Ser Met Glu Glu Cys Gln Lys Leu  
100 105 110



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Gly Leu Thr Lys Ala Ile Gly Val Ser Asn Phe Ser Val Lys Lys Leu  
115 120 125

Gln Asn Leu Leu Ser Val Ala Thr Ile Arg Pro Val Val Asp Gln Val  
130 135 140

Glu Met Asn Leu Ala Trp Gln Gln Lys Lys Leu Arg Glu Phe Cys Lys  
145 150 155 160

Glu Asn Gly Ile Ile Val Thr Ala Phe Ser Pro Leu Arg Lys Gly Ala  
165 170 175

Ser Arg Gly Pro Asn Glu Val Met Glu Asn Asp Val Leu Lys Glu Ile  
180 185 190

Ala Glu Ala His Gly Lys Ser Ile Ala Gln Val Ser Leu Arg Trp Leu  
195 200 205

Tyr Glu Gln Gly Val Thr Phe Val Pro Lys Ser Tyr Asp Lys Glu Arg  
210 215 220

Met Asn Gln Asn Leu His  
225 230

<210> 19  
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<212> PRT  
<213> Opium poppy

<400> 19

Glu Leu Phe Ile Thr Ser Lys Leu Gln Glu Leu Met Ala Ile Pro Asp  
1 5 10 15

Val Val Asn Gln Val Glu Met Ser Pro Thr Leu Val Leu His Gln Ile  
20 25 30

Ala Val Ala Arg Gly Lys Val Asn Glu Ile Pro Lys  
35 40

<210> 20  
<211> 1035  
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<213> Papaver somniferum

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cttttaggtat gggaacagct gaaacaatgg taaaaggaac agaaagagag aaattggcgt 120  
ttttgaaagc gatagaggtc gggttacagac acttcgatac agctgctgca taccaaactg 180  
aagagtgtct tgggtgaagct atagctgaag cacttcaact tgggtctaata aaatctcgag 240  
atgaactctt catcacttcc aagctctggt gcgctgatgc tcacgctgat cttgtcctcc 300

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ctgctcttca gaattctctg aggaatctta aattggacta tcttgatcta tatttgatac 360  
 accatccggt aagcttgaag ccagggaagt ttgttaacga aataccaaag gatcatatcc 420  
 ttccaatgga ctacaaatct gtatgggcag ccatggaaga gtgtcagacc cttggcttca 480  
 ctagggcaat cgggggtctgt aatttctcat gcaaaaggct tcaagagttg atggaaacag 540  
 ccaacagccc tccagttgtg aatcaagtgg agatgagccc gactttacat caaaaaaatc 600  
 tgagggaata ttgcaaggcc aataatatca tgatcaccgc acactcagtt ttgggagccg 660  
 taggtgccgc ctggggcacc aatgcagtta tgcattctaa ggtgcttcac cagattgctg 720  
 tggccagagg aaaatctggt gcccagggtta gtatgagatg ggtttaccag caaggcgcgga 780  
 gtcttgtggt gaaaagtttc aatgaagcga ggatgaagga aaaccttaag atatttgatt 840  
 gggaaactaac ggcagaagac atggaaaaga tcagtgaagt tccacaatct agaacaagct 900  
 ctgctgcttt cttgttatca ccgactggac ctttcaaaac tgaagaagag ttctgggatg 960  
 agaaggattg aaacatcaat tatagatggt aagtgaggac tgtcaaaaaa gtaatcagtt 1020  
 tttccctccg ttttg 1035

<210> 21  
 <211> 966  
 <212> DNA  
 <213> Papaver somniferum

<400> 21  
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 aatgcgatag aggtcgggtta cagacacttc gatacagctg ctgcatacca aagtgaagag 180  
 tgtcttggtg aagctatagc tgaagcactt caacttggtt taataaaatc tcgagatgaa 240  
 ctcttcatca cttccaagct ctggtgcgct gatgctcacg ctgatcttgt cctccctgct 300  
 cttcagaatt ctctgaggaa tctcaaattg gagtaccttg atctatattt gatacaccat 360  
 ccggtaaagct tgaagccagg gaagcttggt aacgaaatac caaaggatca tattcttcca 420  
 atggactaca aatctgtatg ggcagccatg gaagagtgtc agacccttgg cttcactagg 480  
 gcaatcgggtg tcagtaattt ctcatgcaaa aagcttcaag agttgatggc aacagccaag 540  
 atccctccag ttgtgaatca agtgagatg agcccgactt tacatcaaaa aaatctgagg 600  
 gaatattgca aggccaaataa tatcatgatc actgcacact cggttttggg agccataggt 660  
 gctccatggg gcagcaacgc agttatggat tctaagggtgc ttcaccagat tgctgtggca 720  
 agaggaaaat ctggtgccca ggtagtatg agatggggtt accagcaagg cgcgagtctt 780  
 gtggtgaaaa gtttcaatga agcgaggatg aaggaaaacc ttaagatatt tgattcggaa 840  
 ctaacggcag aagatatgga aaagatcagt gagattccgc aatctagaac aagctctgct 900  
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 gattga 966

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<210> 22  
 <211> 966  
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 <213> Papaver somniferum

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 aaagcgatag aggtcgggta cagacacttc gatacagctg ctgcatacca aagtgaagag 180  
 tgtcttggtg aagctatagc tgaagcactt caacttggtc taataaaaatc tcgagatgaa 240  
 ctcttcatca cttccaagct ctggtgcgct gatgctcacg ctgatcttgt cctccctgct 300  
 cttcagaatt ctctgaggaa tcttaaattg gactatcttg atctatattt gatacaccat 360  
 ccggtaaagct tgaagccagg gaagtttggt aacgaaatac caaaggatca tatccttcca 420  
 atggactaca aatctgtatg ggcagccatg gaagagtgtc agacccttgg cttcactagg 480  
 gcaatcgggg tctgtaattt ctcatgcaaa aagcttcaag agttgatggc agcagccaag 540  
 atccctccag ttgtgaatca agtggagatg agcccgactt tacatcaaaa aaatctgagg 600  
 gaatattgca aggccaataa tatcatgata actgcacact cggttttggg agccatatgt 660  
 gctccatggg gcagcaatgc agttatggat tctaagggtc ttcaccagat tgctgtggca 720  
 agagggaaaat ctgttgccca ggtagtatg agatggggtt accagcaagg cgcgagtcta 780  
 gtggtgaaaa gtttcaatga agggaggatg aaggaaaacc ttaagatatt tgattgggaa 840  
 ctaacggcag agaatatgga aaagatcagt gagattccgc aatctagaac aagctctgct 900  
 gatttcttgt tatcaccgac tggacctttc aaaactgaag aagagttctg ggatgagaag 960  
 gattga 966

<210> 23  
 <211> 966  
 <212> DNA  
 <213> Papaver somniferum

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 ggtatgggaa cagctgaaac aatggtaaaa ggaacagaaa gagagaaatt ggcgtttttg 120  
 aaagcgatag aggtcgggta cagacacttc gatacagctg ctgcatacca aagtgaagag 180  
 tgtcttggtg aagctatagc tgaagcactt caacttggtt taataaaaatc tcgagatgaa 240  
 ctcttcatca cttccaagct ctggtgcgct gatgctcacg ctgatcttgt cctccctgct 300  
 cttcagaatt ctctgaggaa tctcaaattg gagtatcttg atctatattt gatacaccat 360  
 ccggtaaagct tgaagccagg gaaatttggt aacgaaatac caaaggatca tattcttcca 420  
 atggactaca aatctgtatg ggcagccatg gaagagtgtc agacccttgg cttcactagg 480  
 gcaatcgggtg tcagtaattt ctcatgcaaa aagcttcaag agttgatggc agcagccaag 540  
 atccctccag ttgtgaatca agtggagatg agccctactt tacatcaaaa aaatctgagg 600  
 gaatattgca aggccaataa tatcatgata actgcacact cggttttggg agccataggt 660

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gctccatggg gcagcaatgc agttatggat tctaaggtgc ttcaccagat tgctgtggca 720  
agaggaaaaat ctgttgccca ggtagtatg agatggggtt accagcaagg cgcgagtctt 780  
gtggtgaaaa gtttcaatga agggaggatg aaggaaaacc ttaagatatt tgattgggaa 840  
ctaacggcag aagatatgga aaagatcagt gagattccgc aatctagaac aagctctgct 900  
gctttcttgt tatcaccgac tggacctttc aaaactgaag aagagttctg ggatgagaag 960  
gattga 966

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<212> DNA  
<213> Papaver somniferum

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caaggccaat aatatcatga tcaactgcaca ctcggttttg ggagccatag gtgctccatg 120  
gggcagcaat gcagttatgg attctaaggt gctt 154

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<212> DNA  
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aatctgaaat tggactacct tgatctatat ttgatacacc atccggtgaag cttgaagcca 120  
gggaagcttg ttaacgaaat accaaaggat catattcttc caatggacta caaatctgta 180  
tgggcagcca tggaagagtgc tcagaccctt ggcttcacta gggcaatcgg tgtcagtaat 240  
ttctcatgca aaaagcttca agagttgatg gcaacagcca agatccctcc a 291

<210> 26  
<211> 321  
<212> PRT  
<213> Papaver somniferum

<400> 26

Met Glu Ser Asn Gly Val Pro Met Ile Thr Leu Ser Ser Gly Ile Arg  
1 5 10 15

Met Pro Ala Leu Gly Met Gly Thr Ala Glu Thr Met Val Lys Gly Thr  
20 25 30

Glu Arg Glu Lys Leu Ala Phe Leu Lys Ala Ile Glu Val Gly Tyr Arg  
35 40 45

His Phe Asp Thr Ala Ala Ala Tyr Gln Thr Glu Glu Cys Leu Gly Glu  
50 55 60

Ala Ile Ala Glu Ala Leu Gln Leu Gly Leu Ile Lys Ser Arg Asp Glu  
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[illegible]

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<211> 321  
 <212> PRT  
 <213> Papaver somniferum

<400> 27

Met Glu Ser Asn Gly Val Pro Met Ile Thr Leu Ser Ser Gly Ile Arg  
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Met Pro Ala Leu Gly Met Gly Thr Val Glu Thr Met Glu Lys Gly Thr  
 20 25 30

Glu Arg Glu Lys Leu Ala Phe Leu Asn Ala Ile Glu Val Gly Tyr Arg  
 35 40 45

His Phe Asp Thr Ala Ala Ala Tyr Gln Ser Glu Glu Cys Leu Gly Glu  
 50 55 60

Ala Ile Ala Glu Ala Leu Gln Leu Gly Leu Ile Lys Ser Arg Asp Glu  
 65 70 75 80

Leu Phe Ile Thr Ser Lys Leu Trp Cys Ala Asp Ala His Ala Asp Leu  
 85 90 95

Val Leu Pro Ala Leu Gln Asn Ser Leu Arg Asn Leu Lys Leu Glu Tyr  
 100 105 110

Leu Asp Leu Tyr Leu Ile His His Pro Val Ser Leu Lys Pro Gly Lys  
 115 120 125

Leu Val Asn Glu Ile Pro Lys Asp His Ile Leu Pro Met Asp Tyr Lys  
 130 135 140

Ser Val Trp Ala Ala Met Glu Glu Cys Gln Thr Leu Gly Phe Thr Arg  
 145 150 155 160

Ala Ile Gly Val Ser Asn Phe Ser Cys Lys Lys Leu Gln Glu Leu Met  
 165 170 175

Ala Thr Ala Lys Ile Pro Pro Val Val Asn Gln Val Glu Met Ser Pro  
 180 185 190

Thr Leu His Gln Lys Asn Leu Arg Glu Tyr Cys Lys Ala Asn Asn Ile  
 195 200 205

Met Ile Thr Ala His Ser Val Leu Gly Ala Ile Gly Ala Pro Trp Gly  
 210 215 220

Ser Asn Ala Val Met Asp Ser Lys Val Leu His Gln Ile Ala Val Ala  
 225 230 235 240

Arg Gly Lys Ser Val Ala Gln Val Ser Met Arg Trp Val Tyr Gln Gln  
 245 250 255

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Gly Ala Ser Leu Val Val Lys Ser Phe Asn Glu Ala Arg Met Lys Glu  
260 265 270

Asn Leu Lys Ile Phe Asp Ser Glu Leu Thr Ala Glu Asp Met Glu Lys  
275 280 285

Ile Ser Glu Ile Pro Gln Ser Arg Thr Ser Ser Ala Asp Phe Leu Leu  
290 295 300

Ser Pro Thr Gly Pro Phe Lys Thr Glu Glu Glu Phe Trp Asp Glu Lys  
305 310 315 320

Asp

<210> 28

<211> 321

<212> PRT

<213> Papaver somniferum

<400> 28

Met Glu Ser Asn Gly Val Pro Met Ile Thr Leu Ser Ser Gly Ile Arg  
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Met Pro Ala Leu Gly Met Gly Thr Ala Glu Thr Met Val Lys Gly Thr  
20 25 30

Glu Arg Glu Lys Leu Ala Phe Leu Lys Ala Ile Glu Val Gly Tyr Arg  
35 40 45

His Phe Asp Thr Ala Ala Ala Tyr Gln Ser Glu Glu Cys Leu Gly Glu  
50 55 60

Ala Ile Ala Glu Ala Leu Gln Leu Gly Leu Ile Lys Ser Arg Asp Glu  
65 70 75 80

Leu Phe Ile Thr Ser Lys Leu Trp Cys Ala Asp Ala His Ala Asp Leu  
85 90 95

Val Leu Pro Ala Leu Gln Asn Ser Leu Arg Asn Leu Lys Leu Asp Tyr  
100 105 110

Leu Asp Leu Tyr Leu Ile His His Pro Val Ser Leu Lys Pro Gly Lys  
115 120 125

Phe Val Asn Glu Ile Pro Lys Asp His Ile Leu Pro Met Asp Tyr Lys  
130 135 140

Ser Val Trp Ala Ala Met Glu Glu Cys Gln Thr Leu Gly Phe Thr Arg  
145 150 155 160

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Ala Ile Gly Val Cys Asn Phe Ser Cys Lys Lys Leu Gln Glu Leu Met  
165 170 175

Ala Ala Ala Lys Ile Pro Pro Val Val Asn Gln Val Glu Met Ser Pro  
180 185 190

Thr Leu His Gln Lys Asn Leu Arg Glu Tyr Cys Lys Ala Asn Asn Ile  
195 200 205

Met Ile Thr Ala His Ser Val Leu Gly Ala Ile Cys Ala Pro Trp Gly  
210 215 220

Ser Asn Ala Val Met Asp Ser Lys Val Leu His Gln Ile Ala Val Ala  
225 230 235 240

Arg Gly Lys Ser Val Ala Gln Val Ser Met Arg Trp Val Tyr Gln Gln  
245 250 255

Gly Ala Ser Leu Val Val Lys Ser Phe Asn Glu Gly Arg Met Lys Glu  
260 265 270

Asn Leu Lys Ile Phe Asp Trp Glu Leu Thr Ala Glu Asn Met Glu Lys  
275 280 285

Ile Ser Glu Ile Pro Gln Ser Arg Thr Ser Ser Ala Asp Phe Leu Leu  
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Ser Pro Thr Gly Pro Phe Lys Thr Glu Glu Glu Phe Trp Asp Glu Lys  
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Asp

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Met Pro Ala Leu Gly Met Gly Thr Ala Glu Thr Met Val Lys Gly Thr  
20 25 30

Glu Arg Glu Lys Leu Ala Phe Leu Lys Ala Ile Glu Val Gly Tyr Arg  
35 40 45

His Phe Asp Thr Ala Ala Ala Tyr Gln Ser Glu Glu Cys Leu Gly Glu  
50 55 60



## J&amp;J-1825.ST25.txt

Ala Ile Ala Glu Ala Leu Gln Leu Gly Leu Ile Lys Ser Arg Asp Glu  
65 70 75 80

Leu Phe Ile Thr Ser Lys Leu Trp Cys Ala Asp Ala His Ala Asp Leu  
85 90 95

Val Leu Pro Ala Leu Gln Asn Ser Leu Arg Asn Leu Lys Leu Glu Tyr  
100 105 110

Leu Asp Leu Tyr Leu Ile His His Pro Val Ser Leu Lys Pro Gly Lys  
115 120 125

Phe Val Asn Glu Ile Pro Lys Asp His Ile Leu Pro Met Asp Tyr Lys  
130 135 140

Ser Val Trp Ala Ala Met Glu Glu Cys Gln Thr Leu Gly Phe Thr Arg  
145 150 155 160

Ala Ile Gly Val Ser Asn Phe Ser Cys Lys Lys Leu Gln Glu Leu Met  
165 170 175

Ala Ala Ala Lys Ile Pro Pro Val Val Asn Gln Val Glu Met Ser Pro  
180 185 190

Thr Leu His Gln Lys Asn Leu Arg Glu Tyr Cys Lys Ala Asn Asn Ile  
195 200 205

Met Ile Thr Ala His Ser Val Leu Gly Ala Ile Gly Ala Pro Trp Gly  
210 215 220

Ser Asn Ala Val Met Asp Ser Lys Val Leu His Gln Ile Ala Val Ala  
225 230 235 240

Arg Gly Lys Ser Val Ala Gln Val Ser Met Arg Trp Val Tyr Gln Gln  
245 250 255

Gly Ala Ser Leu Val Val Lys Ser Phe Asn Glu Gly Arg Met Lys Glu  
260 265 270

Asn Leu Lys Ile Phe Asp Trp Glu Leu Thr Ala Glu Asp Met Glu Lys  
275 280 285

Ile Ser Glu Ile Pro Gln Ser Arg Thr Ser Ser Ala Ala Phe Leu Leu  
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Ser Pro Thr Gly Pro Phe Lys Thr Glu Glu Glu Phe Trp Asp Glu Lys  
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Asp